Research Assessment Exercise 2020
Impact Case Study

University: University of Hong Kong

Unit of Assessment (UoA): Clinical Dentistry (UoA 4)

Title of case study: Improving professional knowledge, patient care and policy for the replacement of missing teeth with resin-bonded bridges

(1) Summary of the impact

Researchers from the Dental Faculty at the University of Hong Kong (HKU) have provided extensive evidence on the clinical design, efficacy and success of metal-ceramic resin-bonded bridges which has informed teaching, clinical practice and patient care in Hong Kong and around the world. In particular, research from this centre has been used to inform guidelines for clinical practice for clinicians and patients available in clinical textbooks, on national websites in Japan as well as changing insurance policy in Germany to allow provision of this conservative, cost effective and successful treatment technique for patients under their government insurance system.

(2) Underpinning research

Tooth loss has a significant effect on the oral health quality of life of patients and resin-bonded bridges (RBBs) are one type of tooth-supported dental prostheses used to replace missing teeth. They require minimal tooth drilling and are held in place by bonding with an adhesive cement to the outer enamel layer adjacent to the missing tooth. However, in the early development of this prosthesis, a lack of a sound evidence-base for tooth preparation and framework design meant there were high failure rates and dentists lacked confidence and considered it a second-rate or inferior dental treatment.

Since 1999, staff from the Dental Faculty led by Prof Michael Botelho (Full-time teacher, 1995-now), Dr Walter Lam (Full-time teacher 2014-now) and other staff have published research evidence over almost 20 years. Their comprehensive range of peer-reviewed papers on metal-ceramic resin-bonded bridges has included: narrative reviews, novel clinical case reports, *in vitro* mechanical testing, finite element analysis, clinical audit and randomized controlled clinical trials. This has built an impactful and substantial evidence base for this treatment which has been used to educate and train dental students and dentists, influence clinical practice, provide evidence for best-practice clinical guidelines and change dental insurance policy.

A major focus of their evidence has focused on two-unit RBBs rather than traditional three-unit fixed-fixed designs. Their long-term follow-up data demonstrate some of the highest success rates in the literature (1). Their data has substantiated the efficacy of this treatment modality to that of *conventional* fixed bridges thereby providing clinicians the confidence to provide two-unit RBBs. Of particular note was a unique randomized clinical trial comparing two-unit cantilever to three-unit fixed-fixed RBBs for replacing upper incisors. The 20-year data were dramatic and irrefutable. All the two-unit designs were successful compared to only 10% of the fixed-fixed designs (2). In another unique study, we reported the clinical success of two-unit RBBs to be equivalent to the considered gold standard tooth replacement, the dental implant and that RBBs had lower complication rates (3) and with no difference in the oral health quality of life and patient satisfaction between RBBs and dental implants (4).

Traditionally two-unit RBBs have been contraindicated to replace missing molars however, HKU have developed a novel prosthesis for these teeth - three-unit fixed-movable prostheses. This centre

is the only one to have reported clinical longevity data on this design and while the short-term outcomes on long-span RBB were very promising with a 93 % success rate (5), longer term success rates were not as good with a 42% success rate (6).

In reaction to this low success rate, two-unit RBBs were proposed to replace missing molars. However, this is not recommended in conventional prosthodontics textbooks. We proposed a randomized clinical trial for replacing missing molars and were awarded a prestigious UGC grant to compare two-unit and three-unit fixed-movable RBBs for missing molar teeth. The results of the *clinical.trials.gov* registered prospective study has been presented at International Association of Dental Research conferences (7) which have demonstrated the success of two-unit RBBs for molar teeth with no significant adverse outcomes. This important data has yet to have full impact but will be used to re-write prosthodontic textbooks and will provide further ongoing evidence to support clinical practice and patient care for missing molar teeth.

(3) References to the research

1. Botelho MG, Ma X, Cheung GJK, Law RKS, Tai MTC, Lam WYH. Long-term clinical evaluation of 211 two-unit cantilevered resin-bonded fixed partial dentures. J Dent. 2014;42(7):778–84.
2. Botelho MG, Chan AWK, Leung NCH, Lam WYH. Long-term evaluation of cantilevered versus fixed–fixed resin-bonded fixed partial dentures for missing maxillary incisors. J Dent. 2016;45:59–66.
3. Lam WYH, Botelho MG, Mcgrath CPJ. Longevity of implant crowns and 2-unit cantilevered resin-bonded bridges. Clin Oral Implants Res. 2013;24(12):1369–74.
4. Lam WYH, Mcgrath CPJ, Botelho MG. Impact of complications of single tooth restorations on oral health-related quality of life. Clin Oral Implants Res [Internet]. 2014;25(1):67–73.
5. Botelho MG, Dyson JE. Long-span, fixed-movable, resin-bonded fixed partial dentures: A retrospective, preliminary clinical investigation. Int J Prosthodont. 2005;18(5):371–6.
6. Lam WYH, Chan RST, Li KY, Tang KT, Lui TT, Botelho MG. Ten-year clinical evaluation of posterior fixed-movable resin-bonded fixed partial dentures. J Dent. 2019;86:118–25.
7. Botelho M, Lam W , An RCT Comparing Molar Two-and Three-unit RBBs, 97th General Session & Exhibition of the IADR, Vancouver, Canada, 2019, ID: 2794 https://iadr.abstractarchives.com/abstract/19iags-3177193/an-rct-comparing-molar-two-and-three-unit-rbbs

(4) Details of the impact

Over the past 19 years, HKU has published the largest body of work globally with 14 publications in peer-reviewed journals focusing on providing evidence on the clinical efficacy of anterior and premolar two-unit RBBs, posterior fixed movable RBBs and novel data on molar two-unit RBBs. These have had and will have further impact on education, clinical practice, policy and clinical guidelines internationally.

Education and training

The influence in dental education is ratified from our online survey of dental schools from selected countries - UK, Australia, Malaysia, Canada, Japan and Germany. In particular 18 out of 22 UK dental schools replied to the survey and that 80% of under-graduate and 72% of post-graduate course included HKU reading materials and that 62.5% of the respondents stated our research influenced teaching and clinical practice with comments from course organizers that:

"[HKU]work has influenced the recommendations made about RBB designs and also provided outcome data useful for both patients and Clinicians"

"This work has developed a new design for RBBs"

"*The work of Botelho on resin bonded bridges is without doubt the key/leading international reference in this field… has increased our understanding and confidence in cantilever resin bonded bridges and altered clinical practice and teaching in this direction*."

"Very important work that directly impacts on patient outcomes via teaching at our UK institution"

In Japan 10 from 19 dental schools reported HKU research to influence their post-graduate teaching practice or clinical care of patients and in Malaysia course leaders shared:

"Paper by Prof Botelho gives us the best design and technique for longevity of RBB. It is supported by the clinical studies conducted in HKU."

"The latest article in 2017 on the success and longevity of RBB conducted in HKU gives me great reassurance of RBB implementation clinically."

Clinical practice

Publications from HKU has influenced dental practitioners with publications and citations in a number of international dental practitioner oriented journals - The British Dental Journal, Journal of the American Dental Association, the Journal of the Canadian Dental Association, the Malaysian Dental Journal, etc. In addition, their work has been cited in several influential dental textbooks (1-3).

In Hong Kong, there is only one dental School and the HKU team have educated students in this evidence-based approach for over 22 years, training approximately 1,200 dentists. This equates to over 50% of the registered dentists in Hong Kong. From an online survey of Hong Kong trained dentists, 96% of respondents (graduating between 1985 and 2017) reported performing two-unit RBBs and that 75.5% of the clinicians reported that publications from HKU influenced their clinical practice.

Research from HKU has led to the acceptance of two-unit RBBs being more likely to be performed, to a predictable standard and by more dental practitioners. This influence has led to good oral health outcomes with regards to high satisfaction and oral health quality of life similar to the considered gold standard of dental implants (4).

Furthermore, the biological cost associated with tooth drilling required for conventional bridgework has been mitigated through expanded use of this minimally invasive technique. This treatment with limited biological cost compared to conventional bridges or dental implants (5) along with its simpler and cost effective treatment makes it more acceptable and accessible to a broader population who will be able to keep their teeth longer and smile more.

Policy, guidelines and patient information

In 2013 the German Association for Prosthetic Dentistry and Biomaterials (DGPro) proposed an evidence-based policy document to the German Social Health Insurance System (GKV) to introduce all-ceramic RBBs as a new treatment item. However, this was not approved as such aesthetically driven treatment was considered non-essential (6). In response to this, the DGPro resubmitted an

amendment to their original application and this included three publications from HKU which helped obtain approval for two-unit, metal-ceramic RBBs through the KZBV in 2015 for dental insurance in Germany

In 2017, the Japan Prosthodontic Society published an online guideline document on RBBs from their Medical Guidelines committee with eight publications from HKU supporting different aspects of adhesive bridges for clinical practice. This document is available to members of their Society and general dentists (9). It was also formally submitted and approved by Medical Information Network Distribution Service (MINDS) for Clinical Practice Guidelines on their website (10). This body is financially supported by the Ministry of Health, Labor and Welfare of Japan with the aim to help medical practitioners utilize evidence-based medicine in their practice and to provide patients with information to help understand their conditions and to share with their practitioners up-to-date best practice for care. Evidence from HKU is being used by dentists and patients in Japan to provide best practice for replacing missing teeth with RBBs.

(5) Sources to corroborate the impact

1. Rosenstiel SF, Land M F, Fujimoto J. Contemporary fixed Prosthodontics. 5th ed. St. Louis, Mo: Mosby Elsevier. Part III Laboratory Procedures Chapter 26: Resin-Bonded Fixed Dental Prostheses 2016, p 712.
2. Klaus WN, Adrian L. Management of Dental Emergencies in Children and Adolescents 1st ed. Wiley Blackwell. Unit 5, Chapter 5.1 Reconstructive Considerations: Temporary and Long-Term Treatment Options, 2019. p. 170.
3. Walmsley AD, Walsh T, Lumley P, Burke FJ, Shortall AC, Hayes-Hall R, Pretty I, Restorative Dentistry, 2nd ed. Churchill Livingstone. Chapter 13, Integrated treatment planning. Elsevier 2007, P.222.
4. Lam WYH, Botelho MG, McGrath CPJ. Longevity of implant crowns and 2-unit cantilevered resin-bonded bridges. Clin Oral Implants Res. 2013;24(12):1369–74.
5. Lam WYH, Mcgrath CPJ, Botelho MG. Impact of complications of single tooth restorations on oral health-related quality of life. Clin Oral Implants Res. 2014;25(1):67–73.
6. Decision of the Joint Federal Committee for the acceptance of the final report of the German Society for Prosthetic Dentistry and Biomaterials eV (DGPro) to review the standard care in accordance with Section 56 Para.2 sentence 11 SGB V Dec 19th 2013 https://www.g-ba.de/downloads/39-261-1892/2013-12-19_Regelversorgung_Abnahme-AB_DGPro.pdf

9. Revised Guidelines for Adhesive bridges published by Japan Prosthodontic Society, Medical Guidelines Committee, 2017 on: http://hotetsu.com/english.html The Japanese document is available at: http://hotetsu.com/s/doc/bridge_guideline2017.pdf. Original document translated by "Deepl.com", Technical terms and words changed for clarity and meaning have been underscored in the translated document.
10. Clinical Practice Guidelines by Medical Information Network Distribution Service – on: https://minds.jcqhc.or.jp/english/english.php The Japanese document is available at https://minds.jcqhc.or.jp/docs/minds/Adhesive-bridge/Adhesive-bridge.pdf#view=FitV